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Mr. Don Ostler  
Bureau of Water Pollution Control  
P. O. Box 16690  
Salt Lake City, UT 84116

DIVISION OF  
OIL, GAS & MINING

Dear Mr. Ostler:

We have reviewed your letters of September 7 and 12, 1988 regarding our proposed gold leach operations at the Goldstrike Mine. Tenneco will respond to the remaining issues raised by these comments but would first like to preface its responses with the following general comments.

Since Tenneco first filed its application in March of this year, it has answered numerous Bureau comments regarding its proposed design. These comments have been contained in letters dated June 1, and June 7, 1988. Tenneco representatives have also met with members of the Bureau staff to discuss the issues on at least four occasions. The record shows that Tenneco has timely responded to all of the Bureau's detailed questions and comments with factual data. However, Tenneco is concerned that these latest two letters from the Bureau have raised additional detailed comments that may take significant amounts of time to resolve thus extending what is already proving to be a permitting time period of over 6 months duration.

When Tenneco first decided to invest in the Goldstrike property it met with all of the State agencies to determine the general approaches taken toward environmental regulations. The Tenneco representatives were informed by the staffs of all of these agencies that site specific environmental and design conditions were considered in determining if an applicant's operations would comply with the State regulations. Since then Tenneco has generally found that the other State agencies, and the applicable Federal and local agencies, have been very cooperative in working toward reasonable environmental protection standards for the project, based on the site-specific characteristics but regrettably, this has not been the case for the Bureau of Water Pollution Control.

Many of the Bureau's comments to date have questioned, and in some cases faulted, Tenneco's design assumptions such as site seismicity, foundation settlement, slope stability, precipitation, temperature, capacity of process solution ponds,



liner material selection, sanitary waste disposal, and operating procedures. The record shows that Tenneco has satisfactorily responded to all of these comments demonstrating its competence and experience in developing this property. However, Tenneco has generally found that the Bureau's comments have displayed an apparent lack of understanding of the basic design and operating characteristics of heap leach facilities. This lack of understanding has been admitted by various Bureau staff members who to date have been very hesitant to accept what are very standard and proven concepts for the industry. Tenneco is also concerned about the Bureau's approach of critically dissecting its designs in a constant "worst case" performance scenario, in some cases recommending design features which provide no incremental addition to protection of the environment. Finally, Tenneco is concerned about the Bureau's stance of rigidly adopting specific, Statewide design standards and regulating in excess of the present policy of protection of beneficial use without ever having requested public review or input on same. These standards are currently being applied to the Goldstrike project in a manner not in concert with the Division of Environmental Health's cooperative public stance of accepting site specific designs and data. Tenneco believes that this current regulatory approach by the Bureau is not supported by the existing regulations and is having the result of holding up the project approval.

Tenneco is concerned about this approach because it believes that if one stands back from the complex correspondence of the last 6 months it should be clear that it has incorporated into the Goldstrike designs every reasonable precaution to prevent pollution. These include:

- 1) Constructing all leach pads and solution ponds with a primary liner of 40 mil HDPE plastic sheeting. This material is known for its ability to stand up to the proposed application through experience in thousands of acres of leach pads throughout the world.
- 2) Placing all of the primary liner for the pads and ponds over an 18-inch thick secondary liner of compacted clay with a tested permeability that has been shown will prevent the breakthrough of leach solutions in the event of a perforation in the plastic liners. In fact, the clay liner under the pads would prevent the release of leach solutions during the life of the facility even if the plastic liner were removed from these facilities.
- 3) Reducing the hydraulic head of leach solutions on the primary liner to less than 1 inch. This will be accomplished through the use of a high-capacity solution collection system placed over the liner. The result of this practice is the reduction of potential seepage of solutions



through any leak in the primary liner.

- 4) Providing a leak detection system under the ponds where the hydraulic head is approximately 5 feet. This leak detection system will detect any leakage of solutions so the leaking pond can be quickly repaired.
- 5) Sizing the entire leach system to contain the 100 yr. 24 hr. precipitation event while maintaining an excess capacity of almost 40% of the total pond volume as a safety margin against discharge.
- 6) Building a sediment pond downstream from the mines and process facilities which has the capacity to contain the 100 yr. 24 hr. precipitation event from the controlled area, even though the State and Federal regulations only require a 10 yr. 24 hr. capacity. This was primarily done in response to concerns about the potential impacts on fish in the East Fork Beaver Dam Wash located approximately 1/2 mile below the sediment pond. Tenneco hastens to point out that such impacts are unlikely because the channel in the Wash is normally dry below the Goldstrike site for a number of miles.
- 7) Installing a comprehensive system of groundwater monitoring wells around the proposed leaching facilities. These wells have been carefully sited and designed to detect any unexpected impacts on the groundwater quality within a short distance from the margins of the pads. This will allow early detection of any groundwater impacts well before the affected groundwater has left the property boundaries.

In addition to its designs for protection of water quality, Tenneco has also presented the Bureau with complete and detailed data on the local environment which shows that:

- 1) The project site is not in the recharge zone of any aquifer flow that is presently used for domestic or agricultural purposes. Based upon the remote and rugged location of the project area, it is very unlikely that domestic or agricultural land uses will be developed near the project site in the future.
- 2) The groundwater that is present in the project area does not support any streams, seeps, or springs for a number of miles downgradient.
- 3) Groundwater under the process facilities has been sampled and water analyses have shown it to naturally contain dissolved metals and other constituents in excess of the State domestic, agricultural, and wildlife beneficial use standards.



- 4) Stream sediment sampling in the ephemeral drainages in and around the project site has shown that the stream sediments are naturally high in metals content, which is not surprising in light of the mineralization that is common to the locality.

In general, Tenneco would like to stress that the Goldstrike Project site is far different from the other gold mining operations that the Bureau has been involved with in northern Utah. Instead of being located in temperate, groundwater recharge areas near present domestic groundwater users like the other Utah gold mines, Goldstrike is located in an arid, dry area with poor quality groundwater which will probably never be utilized for uses other than mining.

Tenneco presents these general comments regarding the past performance of the Bureau in reviewing the permit application, the broad environmental protection attributes of the Goldstrike designs, and the general hydrologic setting of the site not to preempt the Bureau's actions in protecting the waters of the State, but rather to place the overall process in perspective. Tenneco's proposed operations at Goldstrike have the potential for significantly enhancing the State's minerals economy while protecting the quality of the local water resources to every reasonable extent well within the letter and intent of the current regulations.

The following responses to the Bureau's latest two letters are herewith submitted with the hope that this will be the final such correspondence.

Item 4. in the Bureau's 9-7-88 Letter

The Bureau has requested additional information on the handling of sulfide wasterock to prevent the release of soluble sulfate salts.

The following has been reported in Tenneco's Notice of Intent to the Division of Oil, Gas and Mining (DOGM) with regard to the acid-generating potential of the sulfide waste rock from the Hamburg Pit.

"The average acid-base potential (for ore from the Hamburg pit, the only pit with sulfide ore) was -39 tons  $\text{CaCO}_3$ /1000 tons.

Since the acid-forming potential exceeded the -5 tons  $\text{CaCO}_3$ /1000 tons threshold cited by the Division, the material in the Hamburg Pit was analyzed for potential neutralizing agents. The Hamburg Pit, which contains all the sulfide material, also has 2,073,000 tons of limestone. Four samples of this material were analyzed using the same



EPA procedure. The analyses results averaged +603. Thus each ton of limestone could neutralize more than 15 times its own weight in acid or 31,095,000 tons of the identified acid material.

As mentioned above, the sulfide waste amounted to 155,190 tons. A specific location will be designated at the waste dumps for disposal of both acid forming and acid-neutralizing materials. The materials will be mixed by the dumping action of the trucks."

The information already presented to the DOGM is self-explanatory regarding the nature of the problem and the proposed mitigation. The mixing of the sulfide material with the limestone will not require any rigorous program of quality control. The mixing will take place at the dump where truck loads of sulfide material will be dumped along with truck loads of limestone. The limestone volume will be far greater than the sulfide material volume so the net result of the dumping will be the complete encapsulation of the sulfide material with limestone. This will provide the required neutralization capacity to prevent the acidification of the sulfide material.

Migration of soluble sulfate salts from the dumps is not anticipated for two reasons:

- 1) Only seven percent of the waste rock will be sulfide bearing and it will be surrounded with excess neutralizing capacity, therefore only a small proportion of any leachate generated in the dump will be developed in materials which could potentially yield sulfate;
- 2) Mobilization of sulfate salts from the dump requires aqueous or saturated conditions. The dump rock will be coarse and free draining, located in an arid area, and situated above the water table; hence, saturated conditions will not exist in the dump. Therefore, movement of sulfate salts from the dump is not expected to take place.

Item 5. in the Bureau's 9-7-88 Letter

The Bureau comment indicates that there must be provisions to verify the integrity of the entire liner system beneath the leach pads throughout the life of the project.

Tenneco agrees with the Bureau that the pad liner system must be leak free not only for reasons of environmental protection but also for economic reasons, the leach solutions contain gold. However that is as far as Tenneco and the Bureau are apparently in agreement. Tenneco has taken the position of designing the leach pad liner and solution collection systems to standards of performance well in excess of the Bureau's minimal standards with



the intention of providing a large safety margin against leakage. Where the State requires that leach solution heads over the liner be controlled to less than 12 inches, Tenneco has designed a system that should limit the solution heads to under 1 inch. Where the State has required that a 12-inch thick secondary liner of clay be placed under the primary membrane liner, Tenneco has designed an 18-inch secondary liner under not only the pads but also the solution ponds, and the process building evaporation pond (D.E. Pond).

Tenneco has adopted these additional design features for the liners in order to provide a large margin of safety against leakage of solutions through the liners. This additional attempt to eliminate leakage should be given credit by the State and accepted in lieu of requiring a leak detection system.

The balance of this response is the same as the response to Item 1. of the Bureau's 9-12-88 letter.

Item 9. in the Bureau's 9-7-88 Letter

Tenneco is pleased that the Bureau has decided to accept HDPE as a suitable liner material. The Bureau's requirement that the primary liner thickness must be 60 mil instead of 40 mil will add to the capital cost of the project. However, as it can be shown that the thicker material does enhance the ability of the liner to resist punctures, thus enhancing environmental protection, Tenneco will modify its specifications for the thicker material. The liner material will comply with the requirements of the National Sanitation Foundation Standard No. 54 and the installation of the liner will comply with the manufacturer's recommendations. The complete liner material and installation specifications will be submitted to the Bureau by the chosen vendor/installer prior to installation. The recommendations of the Bureau's June 1, 1988 letter regarding the flexible membrane specifications will also be included in the Goldstrike material and installation specifications. Merely increasing the thickness of the membrane liner will not necessitate a redesign of the facilities so the design shown in the March application would still be valid.

Item 10. in the Bureau's 9-7-88 Letter

The Bureau has requested a presentation of the operational procedures which will allow the process ponds to be sized for the design 100 yr. 24 hr. precipitation event.

Tenneco has fully explained the design assumptions for the solution pond sizing in its March application. The 5.7 acre application area from which full yield of the storm precipitation is expected is not something which needs to be controlled by operational procedures. It is based on the physical limitation



of the solution pumping system. The solution application rate will be approximately 0.003 GPM/SF and the maximum barren solution pumping rate will be 750 GPM. Dividing the pumping rate by the application rate gives the maximum area that can physically be leached at any one time, this area is about 5.7 acres.

Item 14. in the Bureau's 9-7-88 Letter

The Bureau has clarified the leakage response categories it proposed in its June 7, 1988 letter.

Tenneco does not consider this issue to be applicable to the Goldstrike operations in that a blanket leak detection system has not been proposed for construction under the pads. Instead, a groundwater monitoring system has been proposed where if any indication of leakage is detected in the monitoring wells, the suspected area of the leach pads will be shut down. In the case of the leach solution ponds, Tenneco has proposed a system of three identical, lined ponds, each with leak detection. In the event of any process solution leakage in one of the two process ponds, the backup pond will be brought into the system and the leaking pond emptied within 7 days of identifying the leak. This 3-pond system is not common in the industry and provides Tenneco a great deal of capability to quickly respond to leaks in the process ponds.

Item 15. in the Bureau's 9-7-88 Letter

The Bureau has reiterated its insistence that the process building evaporation pond (D. E. Pond) must have a leak detection system under it. Then, the Bureau indicates that it has determined that the proposed pond construction is in fact equivalent to a leak detection system.

Tenneco is pleased that the Bureau has incorporated the important site specific design considerations for the D.E. Pond in determining that a leak detection system does not need to be built under the pond. The Bureau has apparently agreed with Tenneco's past assertions that because, 1) the pond will normally only contain washdown and sludge from the filters which contains some cyanide but will normally be removed from the pond by evaporation, 2) the pond will be constructed with 6-inch thick concrete on its sides and bottom to allow occasional sludge removal with equipment, and 3) the concrete sides and bottom of the pond will be backed up with at least 18 inches of compacted clay, a leak detection system is not really warranted under this pond. However, Tenneco would like to recommend that if the Bureau views the D.E. Pond construction equivalent to a leak detection system, then the comparable design and operating characteristics of the pad liners should also be considered equivalent to leak detection. The hydraulic head in the leach



being leached is mineralized which is expected to contribute various constituents to any water leached through it, even without any addition of chemicals or reagents. Lastly, the spent ore can legally be considered a solid waste and as such should be regulated as solid waste. Tenneco is unaware of any State or Federal regulations that require solid waste landfills to yield water of drinking water quality. For these reasons, Tenneco is not willing to agree to the Bureau's proposed pad decommissioning standards at this time but will comply with any pad decommissioning standards that are promulgated by the State Water Pollution Control Committee in the future. This should be acceptable because the Committee is expected to promulgate leach pad rules in the near future, well before Tenneco will decommission any of its leach pads.

Item 27 in the Bureau's 9-7-88 Letter

The Bureau has clarified that any future leaching of ore with liquids on the acid side of the pH scale must be defined in a permit application prior to construction.

Tenneco is in agreement with the Bureau's comment and will provide an application for this process when details are available.

Item 1. in the Bureau's 9-12-88 Letter

The Bureau has commented that timely indication of a breach of the liners to any degree is of paramount importance, that indeterminate amounts of leakage could enter the groundwater prior to detection, and that any pollution of groundwater is unacceptable to any degree.

Tenneco agrees that a breach of the liner system is a concern for both environmental and economic reasons. However, Tenneco has clearly demonstrated in its March 1988 application and in subsequent correspondence that leakage through the double liner system of the pads is impossible unless total failure of both liners occurs. The potential for this to occur is extremely unlikely and would occur only under the condition of a foundation failure which would locally crack the clay liner and tear the overlying plastic liner. Tenneco previously has provided the Bureau with the opinion of its design engineer that the total settlement expected for the liner base will be 2 to 6 inches and it will be uniformly distributed over large areas. This would result in elongations of the clay and plastic liners which are well within the allowable strains for these materials. The Bureau has accepted this analysis and has stated that, "we conclude that the foundation materials will be stable and will provide adequate support for the liner systems". Therefore it should be unnecessary to install leak detection under the liner system for this failure mode.



Leakage of solutions through minor perforations of the primary liner have been shown to be completely contained by the underlying clay liner. The clay liner is 18 inches thick with a permeability of  $2 \times 10^{-7}$  cm/sec. The solution maximum head on the plastic liner has been calculated to be less than 1 inch. We expect to apply leach solutions to each area of any ore lift for approximately 80 days after which time the application system will be moved to another portion of the pad. Tenneco expects to leach up to 5 lifts on any pad, thus each pad area will be leached for up to five 80-day periods, for a total leach time of 400 days during the life of the facilities. Assuming that a hole develops in the plastic liner on day 1 of the operations, the total penetration of solutions into the clay liner under the hole will be less than 3 inches. Therefore it should be unnecessary to install a leak detection under the clay liner to detect leakage through the primary liner only.

Based on the foregoing, Tenneco believes it has already shown that there is a satisfactory safety margin against any leakage through the liner system by nature of its design and the Bureau has already agreed with the liner design. However, the Bureau still continues to request some means of timely indication of a breach through the liners in the event of a hypothetical worst case situation.

At present, Tenneco is extremely concerned with knowing its water mass balance and will monitor both pumped pregnant and barren solution flows via flow meters/totalizers. Additionally, Tenneco will monitor evaporation rates, pond elevations, and water addition to the system to continually evaluate process water needs.

As a paralleling effort, Tenneco's efforts at controlling its water mass balance can be applied to evaluate potential system leakage within the pads. The solution flow data would be accumulated over a weekly period to analyze the mass balance. Thus within a one week response time, Tenneco can determine if significant solution losses (10% of flow or greater) were occurring. Due to the limited area of solution application at any one time, it would be possible to define the potential leak location within any 5.7 acre leach cell. Tenneco recommends that based on the design features preventing leakage that have already been agreed to by the Bureau, the water mass balance system should be acceptable as a means of monitoring potential solution leakage.

Limited impacts on waters of the State of Utah, based on beneficial use criteria, are currently allowable under the existing, properly promulgated, regulations administered by the Bureau. Therefore, Tenneco is uncertain of the basis for the Bureau's statement in its September 12 letter which says, "pollution of ground water is unacceptable to any degree".



the immediate vicinity of the leach pads in the most likely fracture and fault controlled pathways.

The data interpretation presented in the groundwater monitoring proposal is very detailed and site specific. The available data clearly define the potential solution migration pathways and directions. Close-in monitoring wells have been sited such that they are not only "down-structure" along potential contaminant pathways but also down-gradient along the water table surface. In addition, a second line of monitoring wells have been established down-gradient from the process site specifically for the purpose of detecting any leakage that may not be detected by the close-in wells. Thus it is Tenneco's opinion, based upon many hours of geologic and hydrologic interpretation, that it is very unlikely that any leakage beneath the pads will migrate in a manner that will avoid detection.

Tenneco will be pleased to discuss refinement of the proposed monitoring program and the installation of additional wells which the Bureau may suggest; however, it does not agree with the Bureau's implication that the monitoring system will not serve its design function. As with any of its designs submitted to the Bureau, Tenneco's proposed groundwater monitoring system is based on detailed, site-specific data and is therefore worthy of appropriate technical review and comment. General statements of disagreement by the Bureau do not materially assist progress toward finalizing the design of the groundwater monitoring system. If the Bureau finds no specific flaws in the design of the system, Tenneco expects that it should be approved.

Item 3. in the Bureau's 9-12-88 letter

The Bureau has requested that additional information be provided by Tenneco as to the potential remedial actions that would be undertaken in the event of leakage of solutions to the groundwater at the site.

First of all, Tenneco would like to emphasize that it has the personnel and financial resources to rapidly respond to any environmental pollution incident that may occur in connection with the Goldstrike operations. Tenneco Minerals employs over 350 people at 6 locations throughout the United States. Tenneco Minerals has mining projects and operations in 4 states and 1987 total assets over \$300,000,000. Tenneco Minerals is a wholly-owned subsidiary of the Tenneco Company (Tenneco). Tenneco is a diversified natural resources company with over 100,000 employees worldwide and over \$18,500,000,000 in total assets. The staff of the Goldstrike operation is backed by these combined resources which can be brought to bear on any environmental incident.

The first response to a determination that the groundwater in any monitoring well has been impacted by the operations would be to



alert the Bureau of this finding. The immediate remedial action would be to identify the location of the leakage through the water mass balance records. Leaching on this cell or cells would be curtailed until the leakage was stopped. Parallel with this effort would be the initiation of pumping in the monitoring well that contained the contaminated water. This would develop a drawdown area in the vicinity of the monitoring well which would collect other potentially contaminated water within the zone of influence of the drawdown cone, thus reducing the down-gradient spread of the contamination.

The ultimate remedial actions taken to clean up any area of contaminated groundwater would be based on the location, apparent size, and degree of contamination. There are various methods that are widely applied to containment of groundwater pollutants. These include drilling additional pumped wells to intercept and remove the contaminant plume, freshwater injection wells to reverse local groundwater gradients, and in-situ chemical or biological treatment. The water that would be recovered from any pumped wells during remedial actions would be used in the leach process as makeup water. If the operations were not active at the time, the water would be treated as necessary to meet discharge limitations and discharged. Treatment of low levels of cyanide contamination in water is readily accomplished by a number of proven techniques including alkaline chlorination, peroxidation, ultraviolet oxidation in the presence of catalysts, complexing with ferrous sulfate, and acidification followed by neutralization. The effectiveness of any remedial action would be shown by the drilling of additional monitoring wells as needed. The remedial action would be continued until the groundwater quality returned to acceptable quality.

Item 4. in the Bureau's 9-12-88 Letter

The Bureau has commented that monitoring of all wells should continue past the cessation of operations to detect any leakage that may require some time to migrate to the nearest well, and that Tenneco should commit resources to do this. The Bureau has also commented that Tenneco should commit resources to remedial action, should it ever be required.

Tenneco is very amenable to extending the period of monitoring beyond the active life of all leach pads for some defined period of time. The extended monitoring time period is herein proposed to be three years following the final decommissioning and reclamation of the site. This time period should be sufficient for the migration of any leakage to the close-in monitoring wells and is the same period established by the Division of Oil, Gas and Mining to determine the acceptability of the site reclamation actions. It should be noted that the lifetime of individual leach pads will be on the order of one to two years after which they will be decommissioned. This means that certain wells will



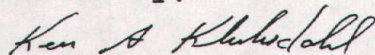
be monitored for periods of up to 9 years following the decommissioning of the upgradient leach pads.

Tenneco is willing to commit itself to providing whatever resources are needed for remedial actions as required for the life of the facilities and the extended monitoring period.

Tenneco hopes that this letter will satisfy the Bureau in regard to the comments contained in its latest two letters. The general prefacing comments in this letter are intended to demonstrate Tenneco's commitment to protecting the environment and to frankly communicate to the State our mounting frustration in convincing the Bureau staff of the sufficiency of the protective measures incorporated in the project designs.

Please feel free to call myself at 673-1606 if there are any questions on this material.

Sincerely,



Ken A. Kluksdahl  
Goldstrike Project Manager

cc: Marty Litus, Tenneco Minerals  
Richard Hodson, Tenneco Minerals  
Brian Buck, JBR Consultants  
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